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(54) **Three dimensional, self-standing puzzle**

Tridimensionale Puzzlekonstruktion

Construction de puzzle en trois dimensions

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**AU-A- 1 971 270** **AU-B- 5 875 186**  
**DE-A- 2 916 985** **GB-A- 438 256**  
**US-A- 3 701 214**

Remarks:

The file contains technical information submitted  
after the application was filed and not included in  
this specification

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## Description

### FIELD OF THE INVENTION

The invention relates to puzzle pieces that can be assembled as a three dimensional, self-standing structure.

### BACKGROUND OF THE INVENTION

A puzzle is a toy that tries the ingenuity and taxes the patience of a player. A puzzle game usually involves the selection and sequential assembly of a plurality of polygonal sheet pieces of varying contour, to recreate an original image about a flat sheet board. More complex puzzle games include assembling a three-dimensional self-standing structure with a variety of puzzle pieces, along edgewise interlocked horizontal and vertical walls.

An example of the latter type of three dimensional puzzle can be found in the recent United States patent No 4,824,112 issued in April 1989 to Roy. An inconvenience with such a puzzle is that non-planar puzzle pieces have to be used, more particularly at the corners of two transverse walls of the self-standing assembled structure - see figure 7a of the Roy reference. This means that two different dies are required for the manufacture of the puzzle pieces: one for the flat, planar pieces, and another for the bent corner pieces. This is inefficient.

Other three-dimensional puzzles rely for their self-standing capability onto locking pins or the like, for anchoring the corner edge portions of pairs of transverse walls forming part of the puzzle. This can be found in U.S. patent 2,569,107 to Johnson. Again, this requires additional particular means distinct from the puzzle pieces as such, a manufacturing inefficiency.

A three-dimensional, self-standing puzzle structure made exclusively of planar puzzle pieces, is disclosed in U.S. patent 3,701,214 issued in 1972 to the Kyoikushuppan Co of Japan (kyoi'). In this patent, each puzzle piece is a flat polygonal block having dovetail joints at its edgewise sections for interlocking engagement with complementary, edgewise, dovetail joints of adjacent puzzle pieces. Adjacent blocks are interlocked by engagement of mating, male and female, complementary dovetail joint elements.

The Kyo'i' patent is interesting, however, it must be quite difficult to assemble the corner parts of the self-standing structure, if each wall is made from a number of puzzle pieces, since the dovetail male element of a first block cannot by definition engage the dovetail female element of a second block within the plane of any of these two blocks. More particularly, as is well known in the art, to interlock male and female dovetail joint elements, they must first be brought in transverse register with one another, and then inserted sidewise through their planes. The male dovetail element certainly cannot be inserted head on through the mouth of

the female dovetail element.

Hence, it is not seen how a complete, enclosed, self standing, continuous, three dimensional structure could be made with the Kyo'i' puzzle pieces, where each wall is constituted by more than one puzzle piece. Indeed, the Kyo'i' patent would probably enable erection of a building structure having two or three, multiple puzzle piece walls, but a fourth and last wall of the building structure enclosing same could not in fact be installed to the two opposite side walls, because the dovetail joints interlocking axis would prevent positioning of the fourth wall edgewise against the two side walls.

Figure 8 of the Kyo'i' patent suggests that an enclosed, albeit discontinuous structure could be constructed with the dovetail joint puzzle pieces thereof. However, for this to occur, each wall of the structure must consist of a single puzzle piece, as illustrated in the figure. Having a self-standing structure with a single modular unit for each wall is not considered by applicant to constitute a true puzzle. In any event, the image from figure 8 of the Kyo'i' patent is discontinuous at the corner edges thereof.

### OBJECTS OF THE INVENTION

The gist of the invention is therefore to provide a three-dimensional, self-standing, puzzle game, in which all puzzle pieces are made from flat sheet material and in which the erected puzzle structure forms a continuous enclosure.

A corollary object of the invention is to reduce the manufacturing costs of three-dimensional puzzle games.

### SUMMARY OF THE INVENTION

To this end, according to the present invention, the modular unit releasably interlockable with another modular unit, the modular unit consisting of a planar, polygonal block defining first and second, opposite, main, flat faces and a peripheral edge joining said first and second faces orthogonally relative thereto, said peripheral edge of said polygonal block defining a number of sides; at least one of said first and second faces of each block forming a small image which, combined with the images from corresponding faces of the other said blocks, form a continuous main image, whereby

said block edge comprises first, dovetail joint means, and second straight tenon and mortise joint means only, positioned on different said sides of said peripheral edge of said polygonal block, to form a three dimensional self-standing structure; and

said first joint means are releasably anchorable to complementary joint means from a second said block edgewise of the first mentioned block within the plane of the latter block to form a flat wall surface; and

said second joint means are frictionally securable to complementary joint means from a third block edgewise of the first mentioned block; and  
 said second joint means specifically allows assemblage of said third block within a plane substantially orthogonal to said first mentioned block, in such a way that a plurality of such modular units form the orthogonal walls of said puzzle structure having a continuous external surface circumscribing an enclosure; and  
 the assemblage of a plurality of said modular units allows forming of vertical walls and a horizontal wall and allows as well that, due to a vertical wall always edgewise sitting against the horizontal wall, interlocking engagement between respective joint means thereof is maintained.

It will be noted that AU-A-19712, which is considered to be the closest prior art, describes gamepieces not only comprising dovetail joint means and straight tenon and mortise joint means, but also comprising projections and indentations of different shapes which makes the gamepieces unsuitable to build a three dimensional puzzle.

In a preferred embodiment, said polygonal block of the modular unit of the invention is made from a main, semi-rigid, compressible yet resilient foam backing, and said image is embedded in a colour film sheet layer glued to the face of said foam destined to face externally of the puzzle structure.

The present invention also relates to a three dimensional puzzle made from such modular units, said puzzle being characterized in that in its assembled state, said puzzle forms a building structure defining a horizontal bottom base wall and vertical side walls interlocked with and edgewise projecting from said base wall, said enclosure being defined between said vertical side walls; and said puzzle including a large, cardboard-based roofing sheet, installed over the top edge defined by said vertical side walls with means being provided for self-support of said roofing sheet thereon.

#### BRIEF DESCRIPTION OF THE DRAWINGS

- Figure 1 is an isometric view of the three-dimensional (3D) puzzle of the invention;
- Figure 2 is an enlarged plan view of the ground level part of the 3D puzzle;
- Figure 3 is an exploded view at an enlarged scale of the modular building blocks of the 3D puzzle, suggesting how a few vertical building blocks can transversely fit onto the horizontal base of figure 2;
- Figure 4 is a perspective view of an intermediate section of the 3D puzzle, illustrating the vertical walls thereof;
- Figures 5-6 are sectional views along lines 5-5 and 6-6 of figure 4, respectively;
- figure 6a is a broken view of the tower part of the 3D puzzle castle of figure 6;

figure 7 is an exploded view of the three modular building blocks, showing both edgewise dovetail joints and U-tenon and mortise joints;

figure 8 shows in perspective view the three modular units of figure 7 in assembled condition;

figures 9 and 9a show in cross-section two embodiments of modular building blocks respectively with one face and two opposite faces thereof bearing an image film;

figure 10 is a perspective view of simulated ground supported vertical struts or columns for transversely supporting a vertical wall of the 3D puzzle castle of figure 1;

figure 11 is a plan view of a third embodiment of modular building block;

figure 12 is a plan view of a tower part of the roofing for the 3D puzzle castle of figure 1;

figures 13-14 show in perspective view how the tower roofing from figure 12 can be fitted onto the tower of the 3-D castle, by the tenon and mortise joints;

figure 15 is a plan view of the main roofing sheet of the 3-D castle; and

figure 16 shows in perspective view how the roofing sheet of figure 15 can befit the vertical walls of the 3-D castle of figure 1.

#### DETAILED DESCRIPTION OF THE INVENTION

A preferred embodiment of the three dimensional, self-standing puzzle is illustrated at 20 in figure 1. 3-D puzzle 20 has the shape of a small castle, but could have any other configuration, of course. Castle 20 generally defines a horizontal ground level 22, upright walls 24 upwardly depending edgewise from the ground base 22, and an inclined roofing 26 supported by the top edges of upstanding walls 24.

Puzzle 20 consists of a plurality of releasably interlocked puzzle pieces 28, as best illustrated in figures 3, 5 and 11. Puzzle pieces 28 constitute polygonal sheets forming modular building blocks or units of variable shape, accordingly with their relative position and function in the puzzle 20. However, the puzzle blocks 28 have common features constituting the heart of the invention. These features are as follows:

- (a) each puzzle block 28 is completely flat and planar;
- (b) within a planar surface, e.g. about base 22 or wall 24, the interlocking joint between each pair of adjacent puzzle block is of the dovetail type, defining complementary female part 30 and male part 32. As best shown in figure 11, the corner edges of male part 32 are preferably smooth and rounded;
- (c) at the marginal or corner portions of two adjacent planar surfaces, e.g. at the intersection of base 22 and upright wall 24, the transverse interlocking joint between each pair of adjacent puzzle block 28 which are transverse to each other, is of the straight

U mortise and tenon type, defining a U-shape mortise part 34 and a quadrangular tenon part 36. Some mortise parts 34' are wider (figure 11), to accommodate two tenon parts 36, 36 from two additional blocks 28, 28 as detailed hereinbelow;

(d) each puzzle block 28 consists of a main semi-rigid backing layer 38, defining two opposite main faces 38a, 38b. Backing 38 is preferably made from compressible, resilient foam. At least one face 38a, 38b and where appropriate both main faces 38a, 38b (see below) bear an additional film layer 40, 42 glued to foam backing 38, see figures 9-9a;

(e) the side edges 28a thereof join the two opposite main faces thereof at 38a, 38b, and are flat and orthogonal to these two main faces, although they may be of irregular height, see particularly figure 4.

It is clear that the dovetail joints 30, 32 which interlock each pair of adjacent coplanar building blocks 28, require for their release relative displacement of these blocks 28 transversely through their common plane. In other words, once blocks 28 are interlocked in a horizontal plane (base 22), each horizontal block 28 needs to be pulled upwardly, that is transversely from the horizontal plane, for its release from an adjacent horizontal block; and once blocks 28 are interlocked in a vertical plane (wall 24), each vertical block 28 needs to be pushed horizontally - transversely from its vertical plane - for its release from an adjacent vertical block 28.

The innovative features lie in the corner joints - figures 7-8 -, where the straight (U-shape) mortise and tenon parts 34, 36 intervene to join two building blocks 28, 28 about two planes transverse to each other. Since the corner joints 34, 36 interlock modular units 28, 28 about transverse, preferably orthogonal planes, there is always a vertical wall edgewise sitting against a substantially horizontal wall. This biases the straight mortise and tenon joint 34, 36 in interlocking state, under the bias of the vertical wall weight. And when release of the straight mortise and tenon joint 34, 36 is required, one needs only to pull a first building block 28 away from the adjacent transverse, second block, within the plane of the first block, to release the tenon from the mortise. To prevent accidental lateral release of the tenon 36 from its mating mortise 36, the dimensions of the former should be only very slightly smaller than that of the latter, whereby friction fit engagement is obtained.

It is understood that such straight joints 34, 36 will enable erecting a building with its upright walls defining a continuous enclosure, i.e. that the lateral upright walls of the building can be interlocked in a continuous fashion around a closed inner chamber. In other words, straight joints 34, 36, will allow installation of all of the side walls, including the last side wall which closes the enclosure.

The reader will recall from the prior art paragraph that U.S. patent 3,701,214 to Sakamoto had puzzle pieces being provided with edgewise joints limited to dovetail type complementary interlocking members. As

a consequence, the Sakamoto joints would prevent interlocking engagement of the last wall closing the enclosure of the 3D puzzle building, in the case of such a puzzle building having walls each made of a plurality of puzzle pieces. Moreover, the Sakamoto 3D puzzle is discontinuous. The present invention is therefore distinct from the Sakamoto reference.

Some mortise parts 34' can be deeper than the other mortise parts 34, as illustrated in figure 7, to enable interlocking of upper and lower vertical blocks 28', 28'' onto an intermediate level horizontal block 28'''. That is to say, the tenons 36'' of the lower blocks 28'' may befit the inner (deeper) side of the deeper mortises 34' of intermediate level block 28''', while the tenons 36' of the upper blocks 28' will then befit the outer (free) side of the mortises 34'' of the intermediate level block 28''', slidingly of adjacent tenons 36'', so that blocks 28', 28'' become parallel to one another.

Looking now more particularly at figures 10-11, the same can be said to be true for two horizontal blocks having a wider female dovetail cavity 34', for securing an intermediate block, as we will see shortly.

It is understood from figure 10 that the image layer 40 of each single image layered block 28 will always be facing outwardly of the castle 20. Of course, there is no point in having that layer facing inwardly, since the owner of puzzle 20 will want to visually appreciate the overall building structure by the combination of the plurality of fragments of images forming an external continuous image with the interlocked blocks 28.

Advantageously, upright sheet columns 44 are added, being made to stand on base 22 and to edgewise abut transversely against the outer face of vertical wall 24. Such exterior sheet columns 44 therefore define two opposite main faces 44a, 44b which both face exteriorly of the castle 20. Then, such columns 44 would benefit from having image layers 38a, 38b on both main faces thereof (figures 9a and 10).

We will now look at the roofing 26 and top edgewise section of the supporting vertical walls 24. Attention is drawn to figures 4-6a and 12-16 of the drawings. Figure 4 clearly shows that while the modular blocks bottom and lateral side edges 28a of the 3D puzzle upright walls 24 comprise the joints 30-32 or 34-36, the top edges 28a' of the castle vertical walls 24 lack any such joints. However, top edges 28a' are of varying heights, to form various simulated architectural figures, e.g. crenels C or towers T for the castle. The tower T can be edgewise supported by a single side only of the main vertical wall, as suggested in figure 6. The top edge of tower T can be completely flat - figure 6 - or could include semi-circular tenon extensions 46 - figure 6a - wherein the former tower would be open at its top end while the latter tower would engage a roofing part 48 at its top end - figure 13.

Various roofing parts 26 are shown in figures 12-16. Each roofing part 26 consists of a thin sheet of semi-rigid material, which is self-supporting onto the top edge 28a' of side walls 24. Sheet roof 26 is thinner than walls

22 or 24. In the first embodiment of roofing in figures 12-14, a flat cardboard sheet 48 will three fold lines 48a, 48b, 48c is bent and closed into a square box 48 opened at its bottom end 48d, as illustrated in figure 13. The bottom edge of box 48 has U-shape cavities 50 for interlocking engagement by semi-circular tenons 46 of tower T. An edge lip 52 engages a slit 54 made in an opposite flap 56 of roof sheet 48, to maintain the assembled box shape of the tower T. The top end of roofing 48 is closed by a triplet of edgewise flaps 58.

The second embodiment of roofing is shown as 60 in figures 15-16. Main roofing 60 is a thin rectangular sheet with flat extensions 62 for hookingly engaging the crenels C in interlocking fashion. Roofing part 60 has a ridge lip 62a for engaging under the main roof sloping part 47 (Figure 1).

Each roofing consists of a substantially rigid backing, e.g. cardboard, covered with a single-colour layer.

#### Claims

1. Modular unit (28) releasably interlockable with another modular unit, the modular unit (28) consisting of a planar, polygonal block defining first and second, opposite, main, flat faces (38a, 38b) and a peripheral edge joining said first and second faces orthogonally relative thereto, said peripheral edge of said polygonal block defining a number of sides; at least one of said first and second faces of each block forming a small image which, combined with the images from corresponding faces of the other said blocks, form a continuous main image characterized in that:

said block edge comprises first, dovetail joint means (30, 32), and second straight tenon and mortise joint means (34, 36) only, positioned on different said sides of said peripheral edge of said polygonal block, to form a three dimensional self-standing structure; and

said first joint means (30, 32) are releasably anchorable to complementary joint means from a second said block edgewise of the first mentioned block within the plane of the latter block to form a flat wall surface; and

said second joint means (34, 36) are frictionally securable to complementary joint means from a third block edgewise of the first mentioned block; and

said second joint means (34, 36) specifically allows assemblage of said third block within a plane substantially orthogonal to said first mentioned block, in such a way that a plurality of such modular units form the orthogonal walls of said puzzle structure having a continuous external surface circumscribing an enclosure; and

the assemblage of a plurality of said modular units allows forming of vertical walls and a hor-

izontal wall and allows as well that, due to a vertical wall always edgewise sitting against the horizontal wall, interlocking engagement between respective joint means thereof is maintained.

2. Modular unit according to claim 1, characterized in that said block is made from a main, semi-rigid, compressible yet resilient foam backing (38), and said image is embedded in a colour film sheet layer (40, 42) glued to the face of said foam destined to face externally of the puzzle structure.
3. A three dimensional puzzle (26) made from modular units (28) according to claim 1 or 2, characterized in that in its assembled state, said puzzle forms a building structure defining a horizontal bottom base wall (22) and vertical side walls (24) interlocked with and edgewise projecting from said base wall, said enclosure being defined between said vertical side walls; and said puzzle including a large, cardboard-based roofing sheet (26), installed over the top edge defined by said vertical side walls with means being provided for self-support of said roofing sheet thereon.

#### Patentansprüche

1. Modulare Einheit (28), die mit einer weiteren modularen Einheit lösbar zusammensteckbar ist, wobei die modulare Einheit (28) aus einem ebenen, polygonalen Block besteht, der erste und zweite, entgegengesetzte, flache Hauptflächen (38a, 38b) und einen Umfangsrand aufweist, der die ersten und zweiten Flächen relativ dazu orthogonal verbindet, wobei der Umfangsrand des polygonalen Blocks eine Anzahl von Seiten aufweist; wobei wenigstens eine der ersten und zweiten Flächen jedes Blocks ein kleines Bild bildet, das in Kombination mit den Bildern von entsprechenden Flächen der anderen Blöcke ein durchgehendes Hauptbild bildet, dadurch gekennzeichnet, daß

der Blockrand erste Schwalbenschwanz-Verbindungsmittel (30, 32) und zweite Verbindungsmittel (34, 36) aus geraden Zapfen und Nuten umfaßt, die auf verschiedenen Seiten des Umfangsrandes des polygonalen Blocks angeordnet sind, um

eine dreidimensionale, freistehende Struktur zu bilden; und

die ersten Verbindungsmittel (30, 32) lösbar mit komplementären Verbindungsmitteln von einem zweiten Block am Rand des ersten genannten Blocks innerhalb der Ebene des letzteren Blocks verankerbar sind, um eine flache Wandoberfläche zu bilden; und die zweiten Verbindungsmittel (34, 36) mit

komplementären Verbindungsmitteln von einem dritten Block am Rand des ersten genannten Blocks durch Reibung befestigbar sind; und

die zweiten Verbindungsmittel (34, 36) insbesondere das Zusammensetzen des dritten Blocks in einer Ebene, die zum genannten ersten Block im wesentlichen orthogonal ist, in solcher Weise gestattet, daß eine Vielzahl solcher modularer Einheiten die orthogonalen Wände der Puzzlestruktur mit einer durchgehenden Außenoberfläche bilden, die eine Mantelfläche darstellt; und das Zusammensetzen einer Vielzahl dieser modularen Einheiten das Ausbilden von vertikalen Wänden und einer horizontalen Platte gestattet, und ebenfalls gestattet, daß aufgrund dessen, daß eine vertikale Wand immer mit dem Rand an der horizontalen Platte sitzt, ein ineinandergreifender Eingriff zwischen ihren jeweiligen Verbindungsmitteln aufrechterhalten wird.

2. Modulare Einheit nach Anspruch 1, dadurch gekennzeichnet, daß der Block aus einem hauptsächlich, halbsteifen, zusammendrückbaren jedoch elastischen Schaumstoffträger (38) besteht und das Bild in eine dünne Farbfilmschicht (40, 42) eingebettet ist, die an die Fläche des Schaumstoffs geklebt ist, die in der Puzzlestruktur nach außen zeigen soll.
3. Dreidimensionales Puzzle (26), das aus modularen Einheiten (28) nach Anspruch 1 oder 2 besteht, dadurch gekennzeichnet, daß das Puzzle in seinem zusammengesetzten Zustand eine Struktur bildet, die eine horizontale untere Basisplatte (22) und vertikale Seitenwände (24) festlegt, die mit der Basisplatte in Eingriff stehen und an den Rändern von der Basisplatte ausgehen, wobei die Mantelfläche durch die vertikalen Seitenwänden festgelegt ist; und wobei das Puzzle eine große Deckplatte (26) auf der Basis von Pappe aufweist, die über dem von den vertikalen Seitenwänden festgelegten oberen Rand mit Mitteln angebracht ist, die zum Selbsttragen der Deckplatte darauf vorgesehen sind.

#### Revendications

1. Une unité modulaire (28) s'emboîtant de façon détachable avec une autre unité modulaire, l'unité modulaire (28) consistant en un bloc planaire et polygonal définissant une première et une seconde faces principales (38a, 38b) opposées et plates, et un rebord périphérique joignant lesdites première et seconde faces orthogonalement par rapport à celles-ci, ledit rebord périphérique dudit bloc polygonal définissant un nombre de côtés; au moins l'une

desdites première et seconde faces de chaque bloc formant une petite image qui, combinée avec les images des faces correspondantes des autres dits blocs, forme une image principale continue, caractérisée en ce que:

ledit rebord du bloc comprend des premiers moyens de joint en queue d'aronde (30, 32), et des seconds moyens de joint en tenon et mortaise droits (34, 36) seulement, positionnés sur des différents dits côtés dudit rebord périphérique dudit bloc polygonal, pour former une structure en trois dimensions autoportante; et lesdits premiers moyens de joint (30, 32) s'attachent de façon détachable à des moyens de joint complémentaires d'un second dit bloc le long du rebord du premier bloc mentionné à l'intérieur du plan de ce dernier bloc pour former une surface de mur plate; et lesdits seconds moyens de joint (34, 36) s'attachent à des moyens de joint complémentaires d'un troisième bloc le long du rebord dudit premier bloc mentionné; et lesdits seconds moyens de joint (34, 36) permettent spécifiquement l'assemblage dudit troisième bloc à l'intérieur d'un plan substantiellement orthogonal audit premier bloc mentionné, de telle manière qu'une pluralité de telles unités modulaires des murs orthogonaux de ladite structure de casse-tête ont une surface externe continue circonscrivant une enceinte; et l'assemblage d'une pluralité desdites unités modulaires permet la formation de murs verticaux et d'un mur horizontal et permet également, grâce à un mur vertical s'appuyant toujours sur un mur horizontal le long de son rebord, de maintenir la relation d'emboîtement entre les moyens de joint respectifs de ceux-ci.

2. Une unité modulaire selon la revendication 1, caractérisée en ce que ledit bloc est fait d'un panneau principal arrière (38) de mousse semi-rigide, compressible mais résiliente, et ladite image est encastrée dans une couche (40, 42) colorée de papier-film collée à la face de ladite mousse destinée à être en regard extérieur de ladite structure de casse-tête.

3. Un casse-tête (26) en trois dimensions fait d'unités modulaires (28) selon la revendication 1 ou 2, caractérisé en ce que dans son état assemblé, ledit casse-tête forme une structure d'édifice définissant un mur inférieur de base horizontal (22) et des murs verticaux de côté (24) emboîtés dans ledit mur de base et faisant saillie du son rebord, ladite enceinte étant définie entre lesdits murs de côté verticaux; et ledit casse-tête incluant une large feuille de toiture (26) à base de carton, installée par-dessus le

rebord supérieur défini par lesdits murs de côté verticaux, des moyens étant fournis pour l'auto-soutien de ladite feuille de toiture sur celui-ci.

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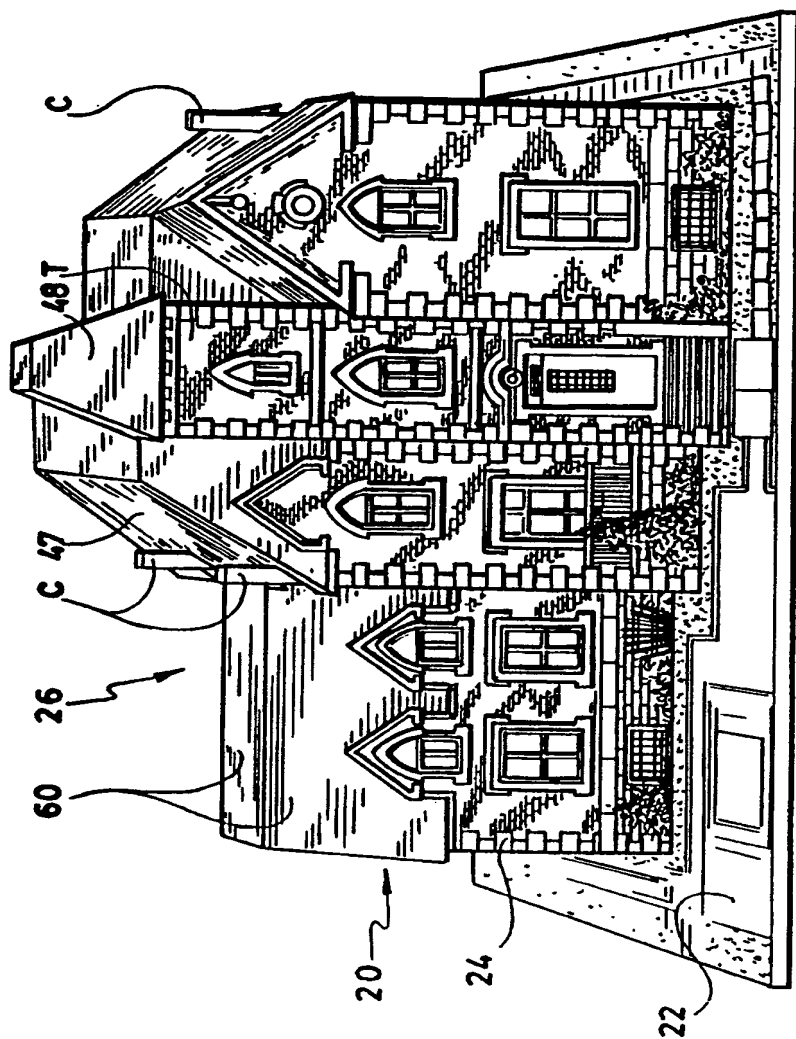


Fig.1



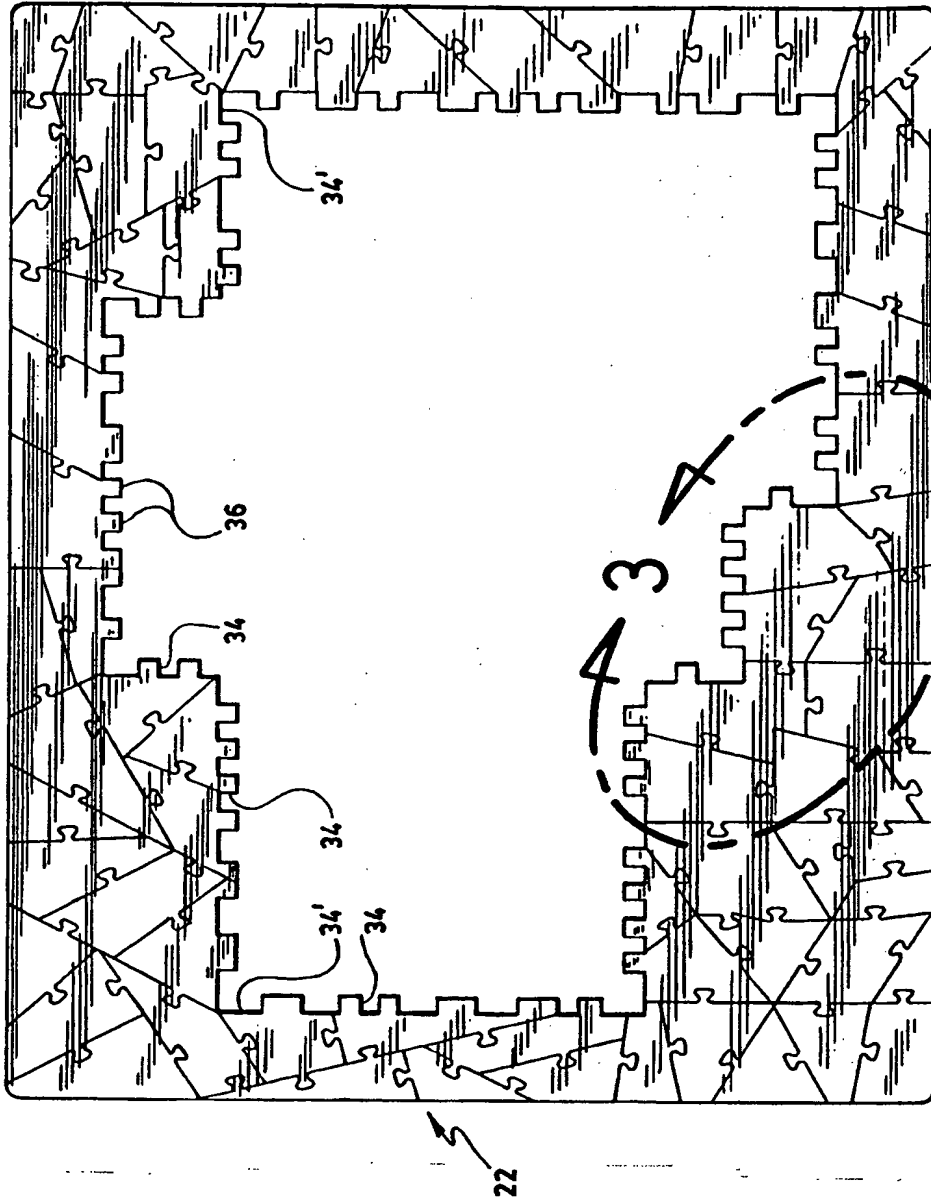


Fig. 2

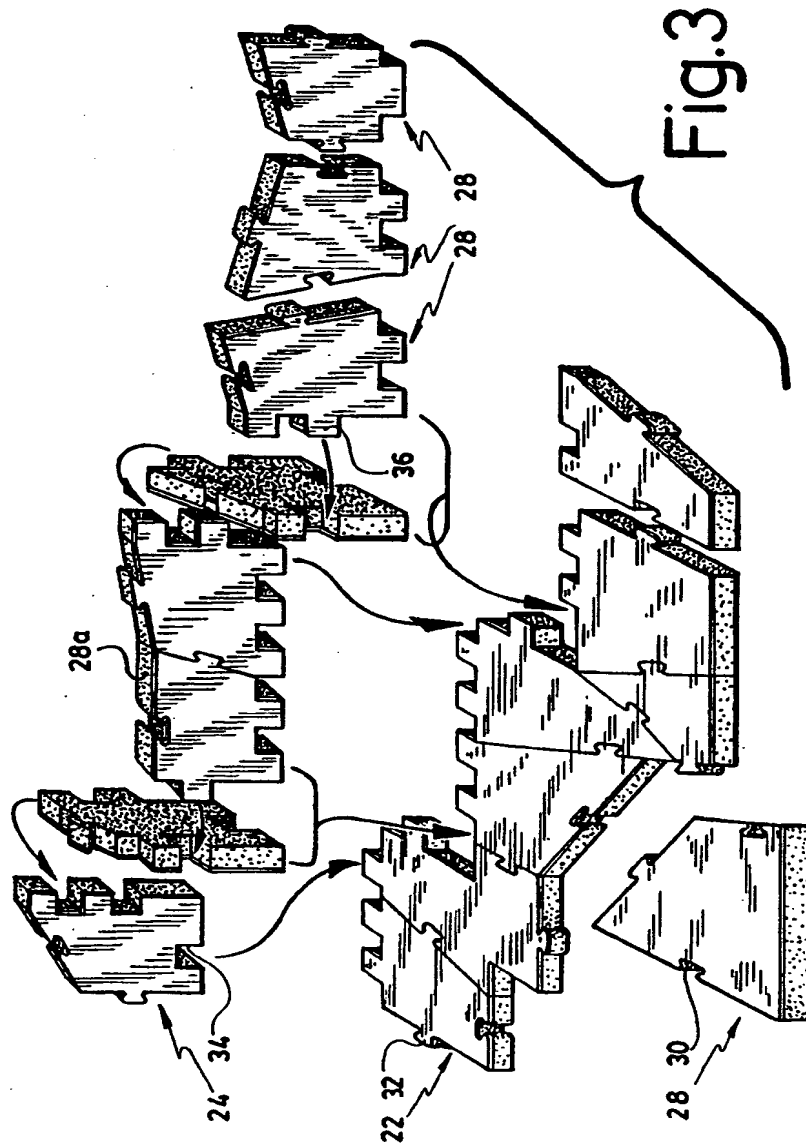
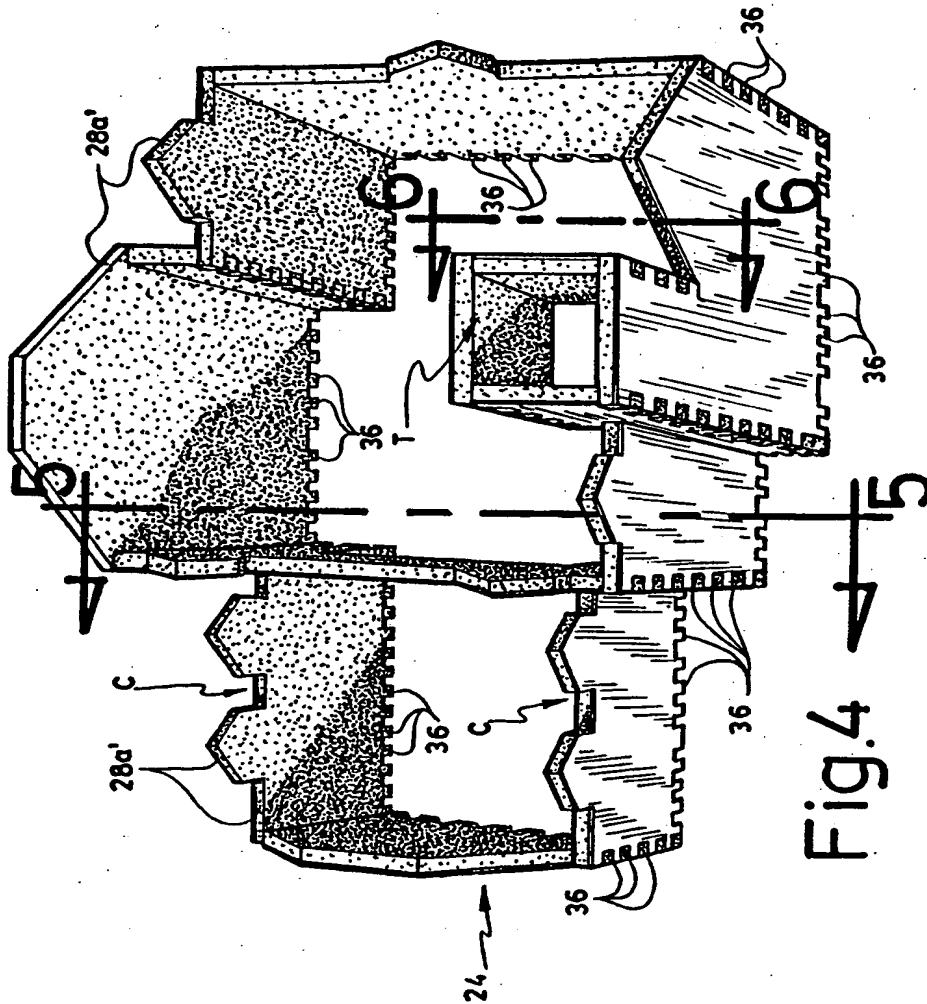


Fig.3



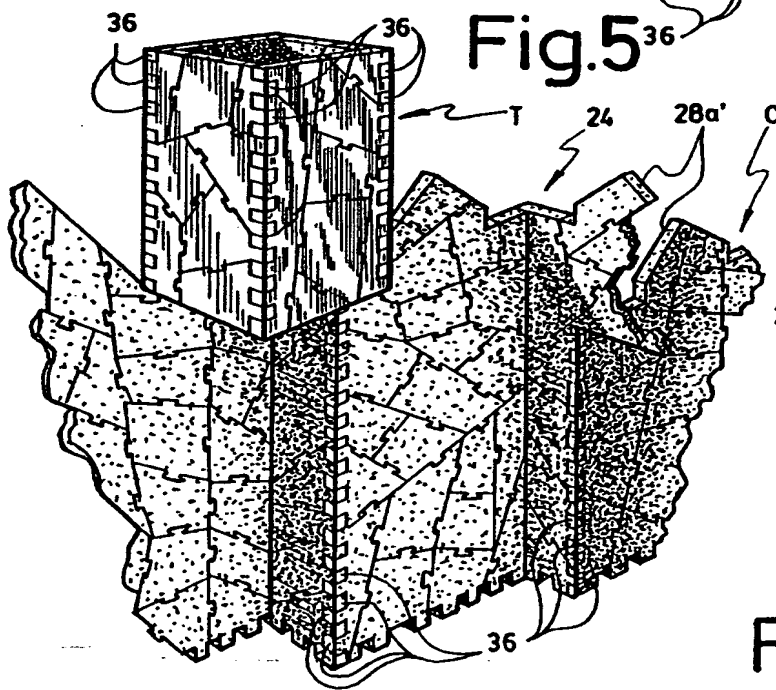
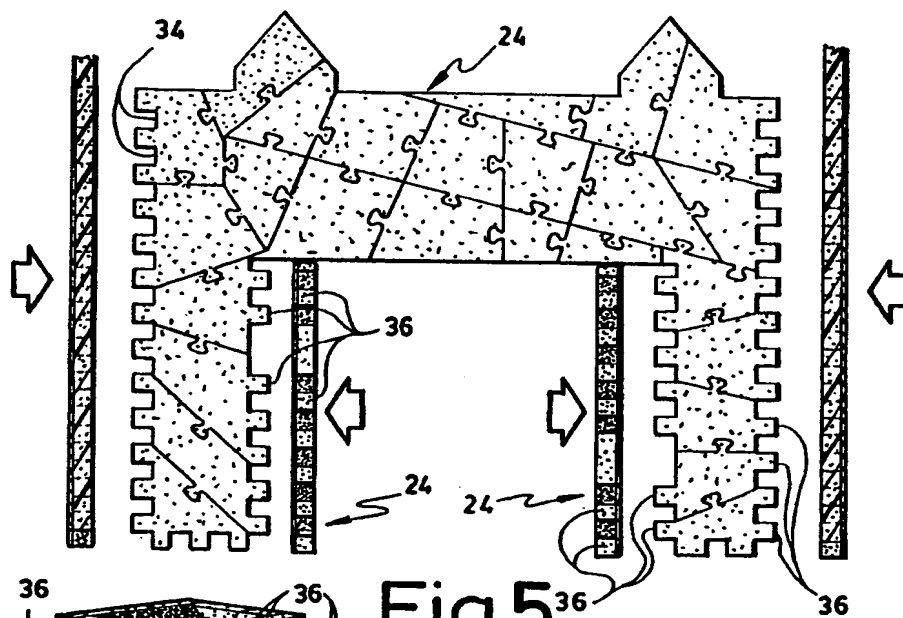


Fig. 6

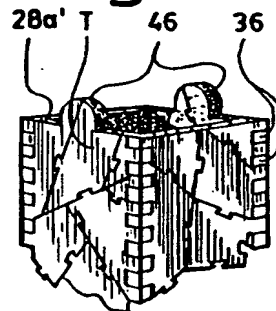


Fig. 6a

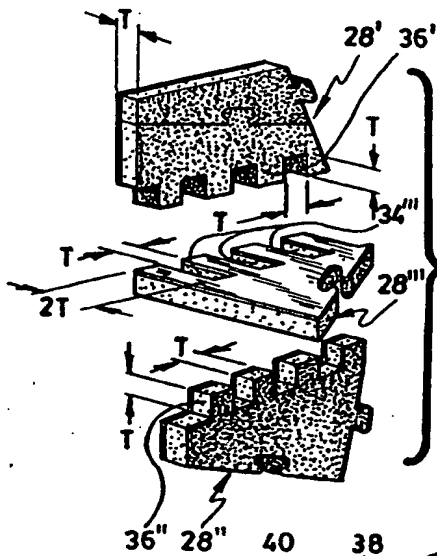


Fig.7

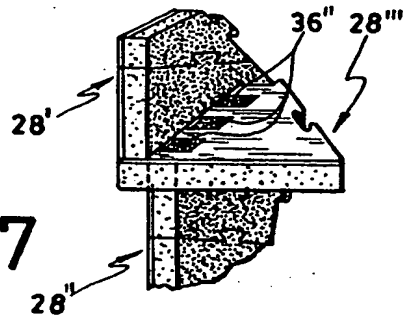


Fig.8

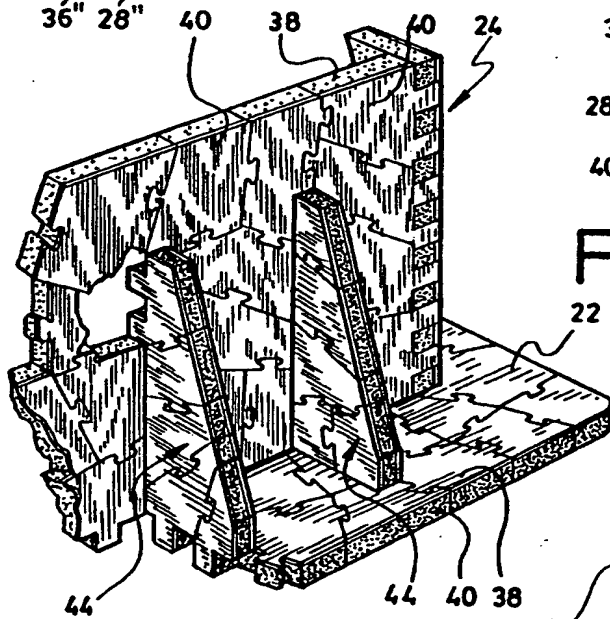


Fig.10

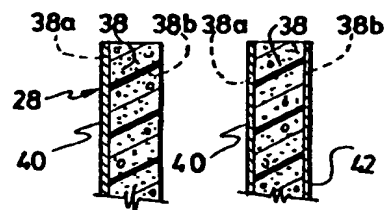


Fig.9 Fig.9a

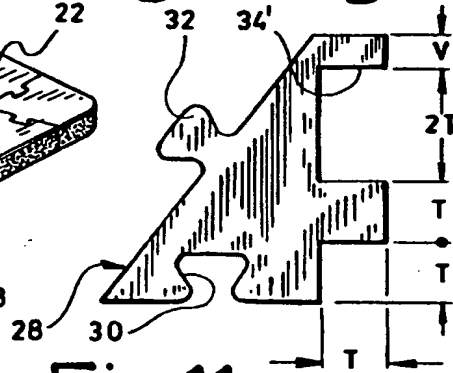


Fig.11

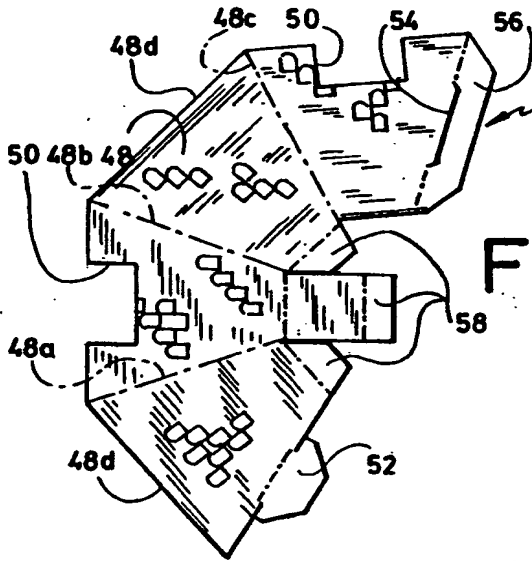


Fig.12

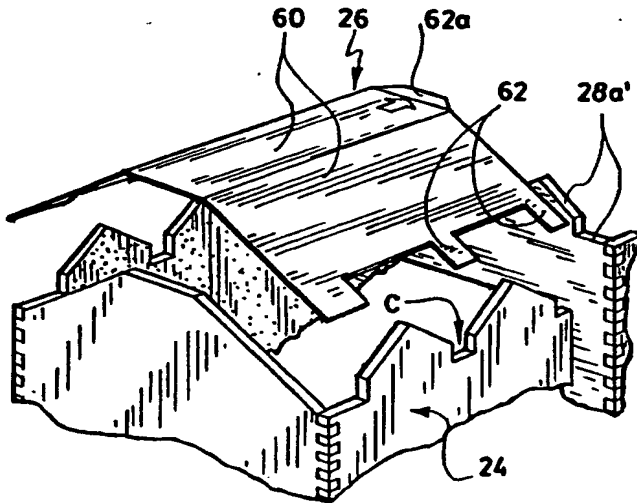


Fig.16

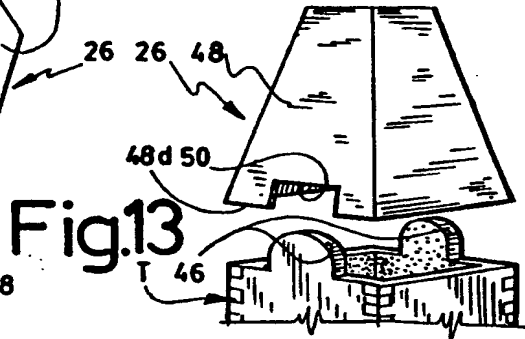


Fig.13

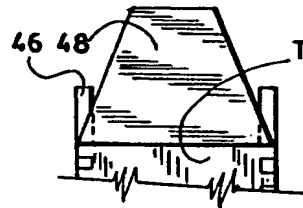


Fig.14

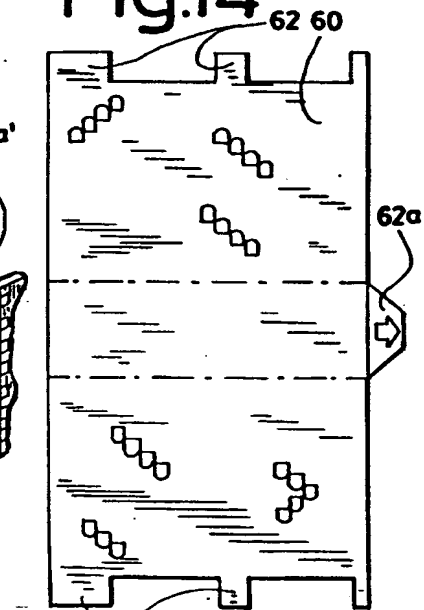


Fig.15

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